Measuring devices for acoustic roughness m|rail and m|wheel
Railway traffic with less wheel noise for your convenience. The foundations are laid by precise measurements of rail and wheel roughness.

The roughness of rails and wheels is the determining factor for the rolling noise of railway vehicles. Consequently, rough running surfaces are of particular importance for railway acoustics.

Especially for acoustic acceptance tests of running trains the comparability of the individual measuring points must be given. For this purpose information on the rail roughness is an essential requirement.

Measuring rail or wheel roughnesses is placing high demands on the measuring instruments’ precision. Irregularities of even less than a millionth of a meter have to be recorded reliably. With many years of experience Müller-BBM has developed robust high-precision measuring devices that comply with these requirements under rough conditions.

Know-how to the full extent – m|rail allows for reliable and fast rail roughness measurements, even with trains running regularly. A normative determination of rail roughness is of particular interest for the execution of acoustic acceptance tests of railways in order to guarantee comparable conditions at different measuring points. m|rail, developed by Müller-BBM, is ideally suited for this purpose. Many years of experience from numerous measurement campaigns and research studies with the previous models (RM1200E, mbbmRM1200) have left their mark on the construction of this device.

m|rail is typically used for:
- The normative quantification of a track section for acoustic acceptance tests (EN ISO 3095, TSI Noise Conventional Rail / High Speed, EN 15610, EN ISO 3381)
- Observing the progress of rail roughness (e.g. after acoustic grinding)
- Determination of input data for acoustic simulations
- Research work

The roughness of rails and wheels is the determining factor for the rolling noise of railway vehicles. Consequently, rough running surfaces are of particular importance for railway acoustics.

Especially for acoustic acceptance tests of running trains the comparability of the individual measuring points must be given. For this purpose information on the rail roughness is an essential requirement.

Measuring rail or wheel roughnesses is placing high demands on the measuring instruments’ precision. Irregularities of even less than a millionth of a meter have to be recorded reliably. With many years of experience Müller-BBM has developed robust high-precision measuring devices that comply with these requirements under rough conditions.
Special attention was paid to the user-friendliness of m|rail. Thus, a transport between measuring sections can be done quickly and easily. Visualized by a line laser the adjustment of the track is carried out fast and straightforward using the measurement software. Real-time viewing of the roughness’ progress is possible with a graphic chart displayed on a computer screen. Immediately after the measurement the determined roughness spectrum of the limiting curves can be compared to the relevant standards. The measurement data will be automatically stored including important information for documentation.

In order to guarantee a reliable use for railway applications m|rail is being operated completely wireless. Data is transferred to the measurement PC (tablet PC) via a W-LAN-interface. Power is supplied by a high-performance battery. Additionally, the device offers the possibility to perform high-speed measurements, it can be removed from the rails at any time simply by lifting.

m|rail can be operated nearly regardless of climatic influence. Its special construction provides for a constant accuracy in strongly different temperatures. A covering cap protects the instrument from the weather. Furthermore, the tablet-PC’s monitor is daylight-suited. The sensor’s vicinity can be illuminated using LED technology for a safe execution of measurements in the dark.

The scope of delivery will include a transport box, a tablet PC, the software »m|rail measure« as well as a training. Optional extras are the analyse software »m|rail analyse« for a normative finishing of the measuring data, a calibration set and an adapter for grooved rails.

m|rail – its most important advantages at a glance

- Robust high-precision measurement system
- High wireless reliability
- User-friendly
- Measuring signal displayed in real-time
- Simple and fast measurement and evaluation, yet conforming to standards
- Measurements regardless of weather conditions
- For all common rail types
- Automatic calibration
m|wheel

Lightweight and precise – m|wheel combines manageability brought to perfection and highest precision.

The measuring device m|wheel has been developed especially for investigating the wheels of railway vehicles. It is typically used for:

- Roughness measurements, polygonisation (unroundness) and eccentricity of wheels
- Detection of wheel flats and further wheel faults
- Gathering of input data for acoustic simulations
- Research work

In the development of m|wheel priority was given above all to a compact, yet robust, design and to the user-friendliness. With an adjustable magnet the measuring device is quickly and easily fixed to the rail, so that the sensor will be in contact with the wheel. For this purpose the vehicle must be lifted. The vernier adjustment of the sensor is then carried out mechanically. m|wheel is connected to any measuring-PC via a USB-interface, which is construed for data transfer and power supply. Thus the measuring device will need neither any external power supply unit nor a battery. The user can comfortably enter the measurement settings using the graphical interface of the measurement software »m|wheel measure« provided with the device. By turning the wheel a magnetic sensor will automatically start the measurement and stop it after exactly one rotation. During the measurement the roughness will be displayed on the screen in a polar diagram or in a Cartesian diagram. Directly after the measurement the roughness spectrum as well as the order spectrum can be seen. The measurement data will be automatically stored including important information for documentation.

The m|wheel scope of delivery will include a transport box and the software »m|wheel measure«. In addition, you will be given a half-day training at our site. Optionally the analyse software »m|wheel analyse« for a finishing of the measuring data is available.

m|wheel – its most important advantages at a glance

- High-precision, small, lightweight, manageable and robust
- Power supply by USB-interface
- User-friendly
- Simple and fast measurement and evaluation
- Fast and simple fixing of the device on the rail
- Quick and easy adjusting of the sensor position
- Start & Stop automatized by magnetic sensor
- Real-time display of the measuring signal, polar / Cartesian diagram
Roughness measuring devices and software by Müller-BBM
precise results – durable use – convenient handling

**Measurement software m|rail analyse**
- Convenient control of m|rail
- Graphics of the roughness signal (real-time)
- Calculation and graphics of the roughness third-octave band spectra
- Implemented limiting curves of relevant standards
- Calibration of m|rail (calibration set required)

**Analyse functions m|rail analyse***
- Import of roughness measurement data
- Graphics of the roughness signal
- Elimination of »spikes«, signal filtration by the rolling wheel according to EN15610
- Calculation and graphics of the roughness third-octave band spectra
- Energetic averaging of roughness spectra
- Implemented limiting curves of relevant standards
- Graphics output conforming with standards

**Measurement software m|wheel analyse**
- Data collection
- Graphics of the roughness signal: Cartesian diagram / polar diagram in real-time
- Calculation and graphics of the roughness third-octave band spectra
- Calculation and graphics of the order spectrum
- Implemented limiting curves of relevant standards

**Analyse functions m|wheel analyse***
- Elimination of »spikes«, signal filtration through contact with the rail
- Averaging of narrow band spectra
- Summation of narrow band spectra to third-octave band spectra
- Presentation of third-octave band spectra in compliance with standards

* optional available
MÜLLER-BBM

Müller-BBM – comprehensive solutions from a single source

Our strengths: consulting, inspecting, measuring, planning

The international engineering company Müller-BBM is represented by more than 300 employees at 13 locations in Germany, Austria and Switzerland. Müller-BBM has been advising clients since 1962 and takes a leading position in the fields of acoustics, audio/video technology, building physics and environmental protection.

<table>
<thead>
<tr>
<th>Technical data m</th>
<th>rail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor type</td>
<td>mechanical displacement sensor</td>
</tr>
<tr>
<td>Measuring length, longitudinal direction</td>
<td>1200 mm</td>
</tr>
<tr>
<td>Scanning in longitudinal direction</td>
<td>0,5 mm</td>
</tr>
<tr>
<td>Driving velocity of the sensor</td>
<td>100 mm/s</td>
</tr>
<tr>
<td>Adjusting range in lateral direction</td>
<td>60 mm</td>
</tr>
<tr>
<td>Resolution in lateral direction</td>
<td>0,5 mm</td>
</tr>
<tr>
<td>Resolution of the sensor</td>
<td>0,1 µm</td>
</tr>
<tr>
<td>Displacement of the sensor</td>
<td>12 mm</td>
</tr>
<tr>
<td>Measuring duration</td>
<td>ca. 20 s per measuring track</td>
</tr>
<tr>
<td>Self-noise level</td>
<td>&lt; –20 dB re 1 µm</td>
</tr>
<tr>
<td>Power supply</td>
<td>Li-Ion-Akku</td>
</tr>
<tr>
<td>Control unit</td>
<td>Measuring PC (tablet-PC)</td>
</tr>
<tr>
<td>Size (extension arm folded)</td>
<td>L x W x H = 350 mm x 290 mm x 1600 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>43 kg</td>
</tr>
<tr>
<td>Software</td>
<td>m</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technical data m</th>
<th>wheel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor type</td>
<td>mechanical displacement sensor</td>
</tr>
<tr>
<td>Resolution of the measuring sensor</td>
<td>0,1 µm</td>
</tr>
<tr>
<td>Displacement of the measuring sensor</td>
<td>12 mm</td>
</tr>
<tr>
<td>Scanning in the wheel rolling direction</td>
<td>1 mm</td>
</tr>
<tr>
<td>Power supply</td>
<td>via USB connection</td>
</tr>
<tr>
<td>Self-noise level</td>
<td>&lt; –20 dB re 1 µm</td>
</tr>
<tr>
<td>Control unit</td>
<td>internal, handled with any measurement PC</td>
</tr>
<tr>
<td>Size, L x W x H</td>
<td>250 mm x 130 mm x 175 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>4,5 kg</td>
</tr>
<tr>
<td>Software</td>
<td>m</td>
</tr>
</tbody>
</table>

Müller-BBM GmbH
Robert-Koch-Strasse 11
82152 Planegg/Munich
Phone +49 (89) 85602-0
Fax +49 (89) 85602-111

www.MuellerBBM.com